NATIONAL BUREAU OF STANDARDS REPORT

5893
(Supplementary)

Report of a Survey of Visual Landing Aids

By
Photometry and Colorimetry Section
Optics and Metrology Division

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

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Inquiries regarding the Bureau's reports should be addressed to the Office of Technical Information, National Bureau of Standards, Washington 25, D. C.

NATIONAL BUREAU OF STANDARDS REPORT

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By
Photometry and Colorimetry Section
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Prepared for
Bureau of Aeronautics
Ship Installations Division
Department of the Navy
Washington 25, D. C.

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TABLE OF CONTENTS

	Page
Physical Data of Landplane Stations	1
Meteorological Data of Landplane Stations	2
Air Operations at Landplane Stations	3
Airfield Lighting and Marking at Landplane Stations	
Approach Lights	4
Runway and Threshold Lights	4
Taxiway Lighting and Marking	5
Control Equipment for Visual Landing Aids	
Lighting Control Panels	6
Other Control Equipment	7
Power Equipment for Visual Landing Aids	
Constant-Current Regulators	8
Emergency Power Equipment	8
Test Equipment Available to Airfield-Lighting Maintenance Personnel	9
Maintenance Personnel Data	
Supervision of Airfield-Lighting Maintenance Personnel	10
Direct Maintenance of Airfield Lighting	10
Physical Data of Seadromes	11
Air Operations at Seadromes	12
Seadrome Lighting and Marking	12
Power Equipment at Seadromes	12

Report of a Survey of Visual Landing Aids

The results of a survey of visual landing aids at seven Naval and Marine Corps Air Stations in California were given in National Bureau of Standards Report 5893. Detailed data on operations and installations at individual air stations were not included in that report. Since these data may be of use in future planning, they have been tabulated and made available in this supplementary report.

The data given in this report are tabulated by headings similar to those used on the Visual Landing Aids Survey Questionnaire. A dash indicates that information was not obtained. "Undetermined" indicates that information was not available.

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PHYSICAL DATA OF LANDPLANE STATIONS

Name of Airfield →	Alameda Naval Air Station	Brown Field Naval Auxiliary Air Station	El Toro Marine Corps Air Station	Miramar Naval Air Station	Moffett Field Naval Air Station	North Island Naval Air Station	Point Mugu Naval Air Station
Location (with coordinates)	Northwest end of Alameda Island, Alameda, Calif. 37°47'N,122°19'W	On Otay Mesa 3 miles east of San Ysidro, Calif. 32°34'N,116°59'W	9 miles southeast of Santa Ana, Calif. 33°40'N,117°44'W	10 miles north of San Diego, Calif. 32°52'N,117°08'W	3 miles northeast of Mountain View, Calif. 37°25'N,122°03'W	North end of Coronado Island, San Diego, Calif. 32°42'N,117°13'W	7 miles south of Oxnard, Point Hueneme, Calif. 34°07'N,119°06'W
Altitude (above sea-level)	15 ft.	523 ft.	380 ft.	475 ft.	38 ft.	24 ft.	13 ft.
Type of Soil	Mostly dredged fill	Adobe over decayed granite	Adobe, sand, and clay	Adobe hardpan with rock and gravel	Adobe	Adobe with some dredged fill	Sandy silt from dredged fill
Cuts and Fills	Mostly fill above mud flats	Grading of fairly flat area	Mostly grading with some shallow cuts and fills	Grading and leveling, no appreciable cuts	Graded with some fill at one end	West end of runway 29 is dredged fill	Mostly dredged fill to raise for adequate drainage
Drainage	Artificial, catch basins and storm sewers	Graded surface drainage	Swales to concrete drainage tiles thru center of runways and natural drainage off runways	Natural except in electrical ducts in large paved areas	Artificial, perforated underdrains	Graded surface drainage and artificial drainage	Graded surface drainage with some catch basins to the subsurface
Topography of the Approaches	03 and 07 - over Bay for 4 miles, then over city of San Francisco; 13 - over Bay for 3 miles then over San Francisco Bay Bridge; 31 - over Bay; 21 and 25 - over cities then over hills 1000-2000 ft. high, 8 miles away	08 - over rolling hills and canyons for 4 miles then over low flat lands to ocean, 10 miles away; 26 - over fairly flat mesa then thru saddle between peaks 3500 ft. high, 8 miles away	03 and 07 - over flat farming area; 16 and 34 - over flat area then over low hills 5 miles away; 21 and 25 - over low hills 3 miles away then over hills up to 5000 ft. high, 12 miles away	06 and 10 - over rolling hills and canyons then over ocean, 7 miles away; 24 and 28 - over flat hills then over hills 1000-1500 ft. high, 5 to 7 miles away	14 - over Bay and salt ponds; 32 - over Bayshore Highway then over orchards and residential area to low mountains 15 miles away	11 and 18 - over beach and water; 29 - over San Diego Bay for 2 miles and then over city of San Diego and mainland; 36 - over beach near city	03 - over water; 02 and 21 - over flat land and water; 27 - over hill 2000 ft. high, 2 miles away

METEOROLOGICAL DATA OF LANDPLANE STATIONS

Name of Airfield →	Alameda Naval Air Station	Brown Field Naval Auxiliary Air Station	El Toro Marine Corps Air Station	Miramar Naval Air Station	Moffett Field Naval Air Station	North Island Naval Air Station	Point Mugu Naval Air Station
Temperature (degrees)							
Maximum	100	108	111	108	102	102	97
Average maximum	64	69	72	70	66	67	64
Mean	55	61	61	61	57	61	58
Average minimum	49	52	50	53	47	56	49
Minimum	29	28	23	30	19	30	30
Precipitation (inches)							
Annual average	23	10	12	9	11	9	9
Annual maximum	-	-	29	18	19	14	17
Annual minimum	-	-	5	4	7	2.5	3
24-hour maximum	-	-	5.27	-	2.23	-	3.90
Winds							
Prevailing direction	W except S in Jan and NW in Dec	W 9 months, NW 2 months, SE 1 month	WNW daylight, E night	NW March to Oct., E Nov to Feb.	NNW except SE in Jan and SSE in Dec.	NW	W
Mean speed (knots)	-	7	5	4	6	7	7
Maximum speed (knots)	61	37	57	21	46	54	77
Visibility							
Annual average number of hours below 2 miles	1400 hr	700 hr	6570 hr (below ½ mi.)	105 hr	570 hr	875 hr (below 2½)	990 hr
Annual average number of hours below ½ mile	70 hr	350 hr	2030 hr	45 hr	100 hr	120 hr (below 5/8)	315 hr (below ⅝ mi.)
Type of fog	Advection	Advection and ground	Advection and radiation	Ground and advection and radiation	Advection and radiation	Advection	Advection
Season of fog	Oct. to Mar.	All year	Aug. to Feb.	Anytime	Oct. to Feb.	May and June	May to Sept.
Ceiling							
Annual average number of hours below 1000 feet	—	1140 hr	1120 hr	790 hr	375 hr	1100 hr	1480 hr
Annual average number of hours below 200 feet		270 hr	230 hr	430 (below 500 ft)	155 hr	—	300 hr
Type of clouds below 1000 feet	—	Stratus and occasionally stratocumulus	Stratus and stratocumulus	Stratus	Stratus	Stratus	Stratus
Number of cloudy days per year	—	135 days	15 days	139 days	—	180 days	135 days
Number of clear days per year	—	175 days	170 days	164 days	—	105 days	190 days
Relative Humidity							
Mean annual (per cent)	—	72	73	72	—	76	76
Lightning							
Average number of days per year	Very rare	Seldom	5 - 10 days	None	2 days	None	None
Snowfall and Frozen Ground	(All stations) None to a maximum of 1.5 inches for one year; no frozen ground						

AIR OPERATIONS AT LANDPLANE STATIONS

Name of Airfield ⟶	Alameda Naval Air Station	Brown Field Naval Auxiliary Air Station	El Toro Marine Corps Air Station	Miramar Naval Air Station	Moffett Field Naval Air Station	North Island Naval Air Station	Point Mugu Naval Air Station
Types of Flight							
Primary	Fleet training	Flight carrier landing practice	Jet training	Jet fighter training	Fleet training	Jet training and fighters	Drone operations
Others	Ferrying, flight testing, and some transients	Utility, helicopter practice and drones	Transports, FCLP, reserves, and transients	Utility, photographic, and some commercial	Transports, NACA flight tests, and general transient	Transport, transients, and test line	Jet operations, pilots proficiency, and logistic transports
Number of Air Operations Per Month							
Total	8000	3000 plus 4500 touch and go	30,000	19,000	25,000	19,000	3200
Jet	6000	1500	19,500	12,000	16,000	2900	1900
Nighttime	800	1125	3000	1900	4000	2900	160

AIRFIELD LIGHTING AND MARKING AT LANDPLANE STATIONS

Approach Lights

Name of Airfield ↓	Number of Runway Approach	Type of System	Type of Lights and Color	Number of Lights or Units	Length of Installation	Date of Installation
Alameda Naval Air Station	31	Range	Range White	2	650 ft	-
Brown Field Naval Auxiliary Air Station	None					
El Toro Marine Corps Air Station	None					
Miramar Naval Air Station	28	Parallel Row	D-1 Red	30	3000 ft	'48-'50
Moffett Field Naval Air Station	32R	Parallel Row	D-1 Red	22	2200 ft	-
North Island Naval Air Station	29	Parallel Row	D-1 Red	30	3000 ft	'43
Point Mugu Naval Air Station	None					

Runway and Threshold Lights

	Number of Runway	Length and Width (ft)	Type of Lights *	Number of Circuits	Number of Lights	Number of these Lights at Threshold	Total Length of Cable (ft)
Alameda Naval Air Station	3-21	5330x500	AN-L-9	1	49	13	18,000
	7L-25R	7200x200	C-1	3	102	24	50,000
	7R-25L	4790x500	AN-L-9	1	53	13	16,000
	13-31	8000x200	C-1	3	108	24	50,000
Brown Field Naval Auxiliary Air Station	8-26	8000x200	M-1	1	104	24	18,000
El Toro Marine Corps Air Station	3-21	7000x200	AN-L-9	1	81	28	20,000
	7L-25R	7500x200	M-1	1	91	28	19,000
	7R-25L	7500x200	M-1	1	98	28	20,000
	16L-34R	8000x200	C-1	3	98	28	37,000
	16R-34L	6000x200	M-1	1	78	28	17,000
Miramar Naval Air Station	6L-24R	8000x200	M-1	1	106	24	31,000
	6R-24L	8000x200	C-1	3	98	28	47,000
	10-28	6000x200	D-1	2	70	16	35,000
Moffett Field Naval Air Station	14L-32R	8060x200	D-1	3	99	24	27,500
	14R-32L	8125x200	AN-L-9	1	104	24	19,500
North Island Naval Air Station	11-29	7500x300	C-1	3	104	28	33,500
	18-36	6000x300	M-1	1	56	12	14,000
Point Mugu Naval Air Station	3-21	7500x200	C-1	3	106	24	29,000
	9-27	5500x200	AN-L-9	1	102	8	15,500

* Some type AN-L-9 or M-1 lights are frequently included with lights of another type.

AIRFIELD LIGHTING AND MARKING AT LANDPLANE STATIONS (continued)

Taxiway Lighting and Marking

Name of Airfield	Length (total) and Nominal Width (ft.)	Number of Circuits	Types of Lights	Number of Lights	Length of Cable (ft)	Type and Use of Destination Markers
Alameda Naval Air Station	40,700x75	15	AN-L-9 M-1	390 55	117,500	TAXI sign from runway 3-21
Brown Field Naval Auxiliary Air Station	9275x75	4	AN-L-9 M-1	47 63	43,350	None
El Toro Marine Corps Air Station	36,350x75	19	M-1 AN-L-9 AN-S-2	826 79 163	190,500	Illuminated signs for high speed refueling, other signs for general information
Miramar Naval Air Station	17,500x75	5	AN-L-9 M-1	229 109	62,500	Internally illuminated arrows and fueling lane signs
Moffett Field Naval Air Station	25,650x75	7	AN-L-9	444	84,000	Illuminated FUEL signs (were not then operative)
North Island Naval Air Station	18,000x100 12,750x75	7	AN-L-9 M-1	254 123	110,000	Some illuminated arrows (were then being installed)
Point Mugu Naval Air Station	6300x75 8000x100	0	Reflector-Delineators	515	None	None

CONTROL EQUIPMENT FOR VISUAL LANDING AIDS

Lighting Control Panels

Name of Airfield ↓	Type	Number	Location	Use
Alameda Naval Air Station	Type II	2	Vault Tower	Runway & misc.
	Type N-1	1	Tower	Taxiway
Brown Field Naval Auxiliary Air Station	Type II with old type switches	2	Tower Vault	Runway, taxiway & misc.
El Toro Marine Corps Air Station	Type II	2	Tower Vault	Runway & misc.
	Type N-1	2	Tower Vault	Taxiway
Miramar Naval Air Station	Type II	3	Tower Vault Spare	Runway, approach & misc.
	Type N-1	1	Tower	Taxiway
Moffett Field Naval Air Station	Type II modified for dual runway control	1	Tower	Runway, approach, & misc.
	Type II	1	Vault	Alternate control
	Type N-1	1	Tower	Taxiway
North Island Naval Air Station	Type II modified*	2	Tower Vault	Runway, approach, & misc.
Point Mugu Naval Air Station	Type II	1	Tower	Runway & misc.

* Modified to use intersecting runways simultaneously; control power is direct current instead of alternating current because of the long control lines.

CONTROL EQUIPMENT FOR VISUAL LANDING AIDS (continued)

Other Control Equipment

Name of Airfield ⟶	Alameda Naval Air Station	Brown Field Naval Auxiliary Air Station	El Toro Marine Corps Air Station	Miramar Naval Air Station	Moffett Field Naval Air Station	North Island Naval Air Station	Point Mugu Naval Air Station
Runway-Selector Cabinets							
Type	AN-C-109	AN-C-109	AN-C-109	AN-C-109	AN-C-109	AN-C-109	AN-C-109
Number	(Average 5 to 6 units at each station)						
Distribution Panelboards							
Type	AN-P-38	AN-P-38	AN-P-38	AN-P-38	AN-P-38	AN-P-38	AN-P-38
Number	(Undetermined at all stations)						
Transfer-Relay Cabinets							
Type	12-pole, double throw	12-pole, double throw	12-pole, double throw	12-pole, double throw	12-pole, double throw	12-pole, double throw	None
Number	(Undetermined at all stations)						
Remote-Control Oil-Switch							
Type	RCOC	RCOC	RCOC	RCOC	RCOC	RCOC	RCOC
Number	(Several at all stations)						
Control Cable							
Type	12/C, #14, 600-volt, lead-covered	16/C, #14, lead-covered, rubber	12/C, #14, lead-covered, rubber	12/C, #14, neo-prene	12/C, #14	26 pair, #22, paper-insulated, lead-covered, telephone type	16/C, rubber-covered
Length	2400 ft	500 ft	1900 ft	1100 ft	3200 ft	12,000 ft	2400 ft
Use	Vault to tower	Vault to tower	Vault to tower	Vault to tower	Vault to tower	Vault to tower	Vault to tower
Date installed	1955	1944	1954	1953	1954	1943	1952

POWER EQUIPMENT FOR VISUAL LANDING AIDS

Constant-Current Regulators

Name of Airfield ↓	Type	Rating	Number	Use
Alameda Naval Air Station	AN-R-17	15KW	3	Runway
	AN-R-17	10KW	1	Taxiway
	AN-R-17	7½KW	1	Taxiway
	CP	10KW	1	Spare
	CP	7½KW	1	Spare
Brown Field Naval Auxiliary Air Station	AN-R-17	15KW	1	Runway
	CP	10KW	1	Taxiway
El Toro Marine Corps Air Station	NC-3	15KW	3	Runway
	AN-R-17	15KW	2	Runway
	AN-R-17	7½KW	2	Taxiway
Miramar Naval Air Station	AN-R-17	15KW	3	Runway
	AN-R-17	7½KW	2	Approach & Runway
	AN-R-17	7½KW	1	Spare
	CP	10KW	1	Taxiway
Moffett Field Naval Air Station	AN-R-17	15KW	3	Runway
	CP	10KW	1	Taxiway
	CP	10KW	1	Spare
North Island Naval Air Station	AN-R-17	15KW	3	Runway
	AN-R-17	7½KW	2	Approach & Runway
	CP	10KW	2	Taxiway
Point Mugu Naval Air Station	NC-3	15KW	3	Runway
	AN-R-17	7½KW	1	Runway

Emergency Power Equipment

	Type	Rating	Test and Emergency Use (Average Hours per Year)	Indicated Need
Alameda Naval Air Station	None	-	-	Not indicated
Brown Field Naval Auxiliary Air Station	None	-	-	Not indicated
El Toro Marine Corps Air Station	Diesel	200KW	104 hrs	Satisfactory
Miramar Naval Air Station	Motor-Generator	125KW	-	Need automatic switchover to standby substation
Moffett Field Naval Air Station	Diesel	125KW	50 hrs	--
	Gasoline	75KW	50 hrs	--
North Island Naval Air Station	None			Need emergency power with automatic switching
Point Mugu Naval Air Station	None			No serious need for emergency power

TEST EQUIPMENT AVAILABLE TO AIRFIELD-LIGHTING MAINTENANCE PERSONNEL

Name of Airfield ⟶	Alameda Naval Air Station	Brown Field Naval Auxiliary Air Station	El Toro Marine Corps Air Station	Miramar Naval Air Station	Moffett Field Naval Air Station	North Island Naval Air Station	Point Mugu Naval Air Station
Routine Test Meters							
Hook-on ammeter	Available	Available	Available	Available	Available	Available	Available
Volt-ohm milliammeter	Not available	Available	Available	Available	Available	Available	Available
Precision Meters							
Alternating current ammeter	Not available	Available	Available	Available	Available	Available	Available
Alternating current voltmeter	Not available	Available	Available	Available	Available	Available	Available
Instrument current transformer	Not available	Available	Available	Available	Available	Available	Available
Instrument potential transformer	Not available	Available	Available	Available	Available	Available	Available
Special Test Equipment							
Low-voltage insulation tester	Available (500 volts)	Available (500 volts)	Available (500 and 1000 volts)	Available (500 volts)	Available (500 volts)	Available (500 and 2500 volts)	Available (2500 volts)
Cable test - detector set (AN/TSM-11)	Available	Available	Available	Available	Available	Available	Available
High-voltage insulation tester (Hypot)	Not available	Not available	Not available	Not available	Available (not used)	Not available	Available
Other special test equipment	---	---	Ground tester (not used)	Wiggins fault locator (not used)	---	Wiggins fault locator (not used)	---
Miscellaneous Test Equipment							
Hot-line clamp-stick	Available	Available	Available	Available	Available	Available	Available
Neon test lamp	Available (test for induced voltages)	Available	Available (periscope type for high voltage test, not liked)	Not available	Available (high voltage type)	Not available	Available (not used)
Other miscellaneous test equipment	---	---	Incandescent test lamp (low voltage test)	Incandescent test lamp (low voltage test)	*Socket adapter (homemade)	---	---

*Others indicated a need for safe, suitable socket adapters.

MAINTENANCE PERSONNEL DATA

Supervision of Airfield-Lighting Maintenance Personnel

Name of Airfield ↓	General Supervision		Direct Supervision	
	Title	Percent of Time Required	Title	Percent of Time Required
Alameda Naval Air Station	Foreman	1%	None	--
Brown Field Naval Auxiliary Air Station	Quarterman	5%	Snapper Electrician	10%
El Toro Marine Corps Air Station	Quarterman Chief Quarterman	2% Less than 1%	Lineman Electrician	5%
Miramar Naval Air Station	Quarterman	1%	Leadingman Electrician	5%
Moffett Field Naval Air Station	Quarterman Foreman	Occasionally Occasionally	Leadingman Electrician	10%
North Island Naval Air Station	None	--	Quarterman	5%
Point Mugu Naval Air Station	Quarterman	Very Little	Leadingman Electrician	Less than 1%

Direct Maintenance of Airfield Lighting

	Direct Responsibility for Airfield-Lighting Maintenance			Others Working on Airfield-Lighting Maintenance		
	Title	Percent of Time Required	Other Duties	Title	Number of Persons	Percent of Time
Alameda Naval Air Station	Lineman Electrician	100%	None	Electrician	1	100%
Brown Field Naval Auxiliary Air Station	Snapper Electrician	10%	Electrician for Public Works	Electricians	3	10%
El Toro Marine Corps Air Station	Electrician	95%	Emergency work elsewhere	Electricians	5	1 - 5%
Miramar Naval Air Station	General Electrician	90%	Emergency and Misc. work	General Electrician	1	90%
				" "	6	1%
Moffett Field Naval Air Station	Leadingman Electrician	5%	In charge of 30 men in other groups	Electricians	2	75%
				" "	10	10%
North Island Naval Air Station	Journeyman Electrician	45%	Street Lighting and Job Orders	Electricians	4	5%
Point Mugu Naval Air Station	Lineman Electrician	25%	Street Lighting	Snapper Electrician	1	5%
				Electricians	5	1%

PHYSICAL DATA OF SEADROMES

Name of Seadrome ⟶	Alameda Naval Air Station Seadrome	North Island Naval Air Station Seadrome	North Island Naval Air Station South Bay Seadrome
Location (with coordinates)	2 miles south of Alameda NAS, Alameda, Calif. 37°45'N,122°19'W	1 mile northeast of North Island NAS, San Diego, Calif. 32°43'N,117°12'W	4 miles southeast of North Island NAS, South San Diego Bay, Coronado, Calif. 32°41'N,117°09'W
Tidal change			
Average	6 ft	4 ft	4 ft
Maximum	12 ft	7 ft	8 ft
Currents			
Type	variable tidal	variable tidal	variable tidal
Average Velocity	4 knots (maximum)	weak	weak
Character of Bottom			
Formation	Fairly flat; 10 feet deep on east side to 30 feet on west side	In channel of Bay with 36 to 48 feet depth	Flat bay bottom dredged to 10-foot minimum depth
Type of soil	Sand with about 1 foot overlay of silt	Mud, sand, and silt	Sand
Shelter of Landing Area	In Bay fairly well sheltered from wind and waves	In channel of Bay good shelter from wind and waves	In South Bay fair shelter from wind, good shelter from waves
Approach and Landing Hazards	Driftwood and debris, and lighting buoys	Ships in channel and lighting buoys	Pile-mounted lights, some light surface craft, debris
Anchorage			
Location	1 mile north of seadrome	Northeast end of North Island, south side of seadrome	None
Minimum depth	11 ft	36 ft	
Protection	Good on 4 sides with jetties on 2 sides	Good protection in Bay	Good protection in Bay
Mooring Buoys			
Number	7	3	0
Location	Inside anchorage	Near ramps	
Ramps			
Number	2 2	2	None
Size	280 ft x 50 ft 205 ft x 50 ft	331 ft x 50 ft	
Capacity	50 tons per square foot		
Beaching Gear			
Number	8 3 13	8 36	None
Type	R3Y PBM P5M	PBM P5M	

AIR OPERATIONS AT SEADROMES

Name of Seadrome →	Alameda Naval Air Station Seadrome	North Island Naval Air Station Seadrome	North Island Naval Air Station South Bay Seadrome
Type of Flight Operations	Seaplane transports, ferrying	Seaplane transports, flight testing	Seaplane landing practice, (touch and go)
Number of Air Operations per Month			
Total	450	600	Undetermined
Nighttime	50	50	Undetermined

SEADROME LIGHTING AND MARKING

Name of Seadrome ↓	Number of Landing Lanes	Length and Width in Feet	Depth in Feet Min.	Depth in Feet Max.	Type and Number of Lights Type	Type and Number of Lights No.	Threshold Lights Color	Threshold Lights No.	Length in Feet of Underwater Cable	Type of Markers for Daytime	Type of Taxiway Lights or Markers
Alameda NAS Seadrome	3-21	8800x1000	10	30	FMF-6B	8	None		10,000	Buoy canvas markers 24-inch diam.	Beacons and orange paint at entrance of breakwater
	7-25	10,000x1000	10	26	FMF-6B	21	Yellow	4			
	12-30	10,000x1000	13	17	FMF-6B	24	Yellow	6			
North Island NAS Seadrome	SE-NW	9600x600-1650	36	48	FMF-6B	9	Yellow	2	None	Buoy canvas markers 24-inch diam.	None
North Island NAS South Bay Seadrome	6-24	9870x1000	10	13	AN-L-10	42	Yellow	12	75,000	Wooden pyramids 6-foot square	None
	14-32	14,875x1000	10	13	AN-L-10	62	Yellow	12			

POWER EQUIPMENT AT SEADROMES

Name of Seadrome	Alameda NAS Seadrome	North Island NAS Seadrome	North Island NAS South Bay Seadrome
Constant-Voltage Regulators			
Type	-	-	CP
Rating	-	-	10KW
Number	-	-	1

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THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its headquarters in Washington, D. C., and its major laboratories in Boulder, Colo., is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside front cover.

WASHINGTON, D. C.

Electricity and Electronics. Resistance and Reactance. Electron Devices. Electrical Instruments. Magnetic Measurements. Dielectrics. Engineering Electronics. Electronic Instrumentation. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Engineering Metrology.

Heat. Temperature Physics. Thermodynamics. Cryogenic Physics. Rheology. Engine Fuels. Free Radicals Research.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Physics. Nuclear Physics. Radioactivity. X-rays. Betatron. Nucleonic Instrumentation. Radiological Equipment.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Molecular Structure and Properties of Gases. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Fluid Mechanics. Engineering Mechanics. Mass and Scale. Capacity, Density, and Fluid Meters. Combustion Controls.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Concreting Materials. Constitution and Microstructure.

Building Technology. Structural Engineering. Fire Protection. Air Conditioning, Heating, and Refrigeration. Floor, Roof, and Wall Coverings. Codes and Safety Standards. Heat Transfer.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics.

Data Processing Systems. SEAC Engineering Group. Components and Techniques. Digital Circuitry. Digital Systems. Analog Systems. Application Engineering.

- Office of Basic Instrumentation.
- Office of Weights and Measures.

BOULDER, COLORADO

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

Radio Propagation Physics. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Sun-Earth Relationships. VHF Research.

Radio Propagation Engineering. Data Reduction Instrumentation. Modulation Systems. Navigation Systems. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Radio Systems Application Engineering. Radio Meteorology.

Radio Standards. High Frequency Electrical Standards. Radio Broadcast Service. High Frequency Impedance Standards. Calibration Center. Microwave Physics. Microwave Circuit Standards.

NBS